

AMENDMENTS TO THE CLAIMS

The following list of claims is intended to replace all prior versions or listings of claims in the application.

Listing of Claims:

1. – 9. **(Canceled)**

10. **(Currently Amended)** A machine comprising:

a computing device for determining an implied volatility of an American option, wherein said device is configured to:

generate a binomial tree having a plurality of nodes, each node corresponding to a different sub-period of time during which the American option can be exercised prior to the time when the option expires;

compute a value for node vega at each node of the binomial tree for the corresponding sub-period of time using a single volatility for all nodes in the binomial tree;

compute a value for vega for the binomial tree using ~~a function of~~ the values for node vega computed at the nodes; and

compute a value for the implied volatility of the American option using a ~~function of~~ the value of vega computed for the binomial tree.

11. **(Currently Amended)** The machine of Claim 10, wherein the computing device ~~computes~~ is configured to compute the value for node vega at ~~each~~ a node ~~is~~ as the exact derivative of the option price with respect to the volatility when the option is not exercised at the sub-period of time corresponding to the node.

12. **(Currently Amended)** The machine of Claim 10, wherein the computing device ~~computes~~ is configured to compute the value for node vega at a node as a function of the security price of the option when the option is exercised at a sub-period of time corresponding to the node.

13. **(Currently Amended)** The machine of Claim 12, wherein the computing device ~~computes~~ is configured to compute the value for node vega at ~~each~~ a node as a function of the index price of the option when the option is exercised at a sub-period of time corresponding to the node.

14. **(Previously Presented)** The machine of Claim 10, wherein said computing device is configured to calculate the implied volatility of the American option iteratively using new values for node vega in each iteration until the computed price of the American option converges to the market price of the American option.

15. **(Previously Presented)** The machine of Claim 14, wherein said computing device is configured to calculate the new values for implied volatility in each iteration using the Newton-Raphson method.

16. **(Previously Presented)** The machine of Claim 10, wherein said computing device is configured to calculate the price of the option at each node at the same time as the computing device calculates node vega at the node.

17. **(Currently Amended)** A method for determining an implied volatility of an American option, wherein said method comprises:

- generating a binomial tree having a plurality of nodes, each node corresponding to a different sub-period of time during which the American option can be exercised prior to the time when the option expires;

- computing a value for node vega at each node of the binomial tree for the corresponding sub-period of time using a single volatility for all nodes in the binomial tree;

- computing a value for vega for the binomial tree using ~~a function~~ of the values for node vega computed at the nodes; and

- computing a value for the implied volatility of the American option using ~~a function~~ of the value of vega computed for the binomial tree

wherein each of the computing steps is performed by a computing device.

18. **(Currently Amended)** The method of Claim 17, wherein the value for node vega at each a node is calculated as the exact derivative of the option price with respect to the volatility when the option is not exercised at the sub-period of time corresponding to the node.

19. **(Currently Amended)** The method of Claim 17, wherein the value for node vega at each a node is calculated as a function of the security price of the option when the option is exercised at a sub-period of time corresponding to the node.

20. **(Currently Amended)** The method of Claim 19, wherein the ~~the~~ value for node vega at each a node is calculated as a function of the index price of the option when the option is exercised at a sub-period of time corresponding to the node.

21. **(Previously Presented)** The method of Claim 17, wherein computing the value of the implied volatility of the American option comprises calculating node vega iteratively using new values for each iteration until the computed price of the American option converges to the market price of the American option.

22. **(Previously Presented)** The method of Claim 21, wherein calculating the new values for implied volatility in each iteration comprises using the Newton-Raphson method.

23. **(Previously Presented)** The method of Claim 17, wherein node vega and the price of the option are calculated at the same time for each node.

24. **(Previously Presented)** The machine of claim 10, wherein said machine is configured to compute a value for vega for the binomial tree recursively using ~~a recursive function~~ of the values for node vega computed at the nodes.

25. **(Previously Presented)** The method of claim 17, wherein said computing of a value for vega for the binomial tree is conducted recursively using ~~a recursive function of the~~ values for node vega computed at the nodes.

26. **(Currently Amended)** The machine of Claim 10, wherein said computing device ~~computes~~ is configured to compute a value for the option price at each node and the node vega for the corresponding sub-period of time ~~is computed~~ using the option price of a node corresponding to a subsequent period of time.

27. **(Previously Presented)** The method of Claim 17, comprising the step of computing a value for the option price at each node and wherein the value for the node vega for a sub-period of time is computed using the option price of a node corresponding to a subsequent period of time.

28. **(Currently Amended)** A machine comprising:
a computing device for determining implied volatility of an American option, wherein said device is configured to:

iteratively generate a new tree for each new value of volatility, the tree having a plurality of nodes, each node corresponding to a different sub-period of time during which the American option can be exercised prior to the time when the option expires;

calculate a value of vega for each tree using values of the option price calculated at nodes of a single tree using a single volatility for all nodes in the single tree; and,

calculate the implied volatility of the option using ~~a function of the~~ values calculated for vega for the trees.

29. **(New)** The machine of Claim 10, wherein, when the option is not exercised at a sub-period of time i corresponding to a node, said computing device is configured to compute a value for node vega at the node as:

$$\frac{\partial C_i}{\partial \sigma} = \left(\frac{1}{R}\right) \times \left[p \frac{\partial C_{i+1}^{UP}}{\partial \sigma} + (1-p) \frac{\partial C_{i+1}^{DOWN}}{\partial \sigma} + (C_{i+1}^{UP} - C_{i+1}^{DOWN}) \frac{\partial p}{\partial \sigma} \right],$$

where C_{i+1}^{UP} and C_{i+1}^{DOWN} are the option prices at the end of the sub-period i when the price moves up and down, respectively, σ is volatility, and p is a probability.

30. **(New)** The machine of Claim 10, wherein, when the option is exercised at a sub-period of time i corresponding to a node, said computing device is configured to compute a value for node vega at a node as $\frac{\partial C_i}{\partial \sigma} = \frac{\partial S_i}{\partial \sigma}$, where S_i is the security price at the beginning of the sub-period of time i and σ is volatility.

31. **(New)** The method of Claim 17, wherein, when the option is not exercised at a sub-period of time i corresponding to a node, the value for node vega at the node is computed as:

$$\frac{\partial C_i}{\partial \sigma} = \left(\frac{1}{R}\right) \times \left[p \frac{\partial C_{i+1}^{UP}}{\partial \sigma} + (1-p) \frac{\partial C_{i+1}^{DOWN}}{\partial \sigma} + (C_{i+1}^{UP} - C_{i+1}^{DOWN}) \frac{\partial p}{\partial \sigma} \right],$$

where C_{i+1}^{UP} and C_{i+1}^{DOWN} are the option prices at the end of the sub-period i when the price moves up and down, respectively, σ is volatility, and p is a probability.

32. **(New)** The method of Claim 17, wherein, when the option is exercised at a sub-period of time i corresponding to a node, the value for node vega at the node is computed as $\frac{\partial C_i}{\partial \sigma} = \frac{\partial S_i}{\partial \sigma}$, where S_i is the security price at the beginning of the sub-period of time i and σ is volatility.

33. **(New)** The machine of claim 24, wherein said machine is configured to compute a value for vega for the binomial tree using a recursive function of the values for node vega computed at the nodes,

wherein, when the option is not exercised at a sub-period of time i corresponding to a node the recursive function is $\frac{\partial C_i}{\partial \sigma} = \left(\frac{1}{R}\right) \times \left[p \frac{\partial C_{i+1}^{UP}}{\partial \sigma} + (1-p) \frac{\partial C_{i+1}^{DOWN}}{\partial \sigma} + (C_{i+1}^{UP} - C_{i+1}^{DOWN}) \frac{\partial p}{\partial \sigma} \right],$

where C_{i+1}^{UP} and C_{i+1}^{DOWN} are the option prices at the end of the sub-period i when the price moves up and down, respectively, σ is volatility, and p is a probability, and

wherein, when the option is exercised at a sub-period of time i corresponding to a node, the recursive function is $\frac{\partial C_i}{\partial \sigma} = \frac{\partial S_i}{\partial \sigma}$, where S_i is the security price at the beginning of the sub-period of time i and σ is volatility.

34. (New) The method of claim 25, wherein said computing of a value for vega for the binomial tree is conducted using a recursive function of the values for node vega computed at the nodes,

wherein when the option is not exercised at a sub-period of time i corresponding to a node the recursive function is $\frac{\partial C_i}{\partial \sigma} = \left(\frac{1}{R}\right) \times \left[p \frac{\partial C_{i+1}^{UP}}{\partial \sigma} + (1-p) \frac{\partial C_{i+1}^{DOWN}}{\partial \sigma} + (C_{i+1}^{UP} - C_{i+1}^{DOWN}) \frac{\partial p}{\partial \sigma} \right]$,

where C_{i+1}^{UP} and C_{i+1}^{DOWN} are the option prices at the end of the sub-period i when the price moves up and down, respectively, σ is volatility, and p is a probability, and

wherein, when the option is exercised at a sub-period of time i corresponding to a node, the recursive function is $\frac{\partial C_i}{\partial \sigma} = \frac{\partial S_i}{\partial \sigma}$, where S_i is the security price at the beginning of the sub-period of time i and σ is volatility.

35. (New) The machine of Claim 28, wherein said computing device is configured to use the Newton-Raphson method to iteratively calculate the value for the implied volatility of the American option using the values calculated for vega for the trees.